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SHOULDER BELT HEIGHT ADJUSTER ASSEMBLY AND METHOD

TECHNICAL FIELD OF THE INVENTION

The present invention relates generally to vehicular restraint systems. More particularly, the invention relates to a shoulder belt height adjuster assembly and method of operating the same.

BACKGROUND OF THE INVENTION

Motor vehicles typically include active restraint systems such as over-the-shoulder safety belts. Such belts are generally attached to a vehicle door pillar at a position slightly above a passenger shoulder. As a passenger's height may vary considerably, it is sometimes desirable to provide a strategy for adjusting the vertical pillar position of the shoulder belt relative to the passenger. Adjustment of the shoulder belt height at the pillar position may offer optimal safety belt operation and ergonomics.

Several strategies developed to provide shoulder belt height adjustment involve the use of a slidable member that moves vertically relative to a guide rail mounted to the vehicle pillar. Examples of such strategies include U.S. Patents Nos. 5,758,901 to Harenberg; 5,911,439 to Pleyer *et al.*; 5,941,566 to Holzapfel *et al.*; and 6,334,629 to Griesemer *et. al.*, which are incorporated by reference herein. In the Griesemer patent, for example, an adjustment carriage (e.g., the slidable member) includes an arresting mechanism that selectively allows the carriage to engage openings formed in a guide rail. Each engagement opening provides a discrete locking adjustment location. As such, a plurality of discrete locking positions are provided, but the number of height adjustment positions is limited to the number of the openings.

Although such patents disclose strategies that may effectively provide shoulder belt height adjustment, they typically provide a relatively small number of adjustment positions. It is possible to increase the number of engagement openings, however, this may reduce the integrity of the parts and/or increase the complexity and cost of the belt assembly. Accordingly, it would be desirable to provide a larger number of shoulder belt adjustment positions without the need for numerous engagement openings.

Another shoulder belt height adjustment strategy that involves the use of a slidable member moveable within a guide rail includes U.S. Patent No. 5,779,273 to Schmidt, which is incorporated by reference herein. In the Schmidt patent, an adjusting element (e.g., the slidable member) includes two rotatable gears providing movement relative to a guide rail. In the Schmidt and other patents (e.g., 5,758,901 to Harenberg and 5,941,566 to Holzapfel *et al.*), moveable parts (e.g., gears, levers, etc.) are provided as part of the shoulder belt height adjustment assembly. The use of such auxiliary moveable parts may increase the complexity, cost, and failure rate of the assembly. Accordingly, it would be desirable to provide a shoulder belt height adjustment strategy that does not use auxiliary moveable parts.

Therefore, it would be desirable to provide a shoulder belt height adjuster assembly and method of operation that overcomes the aforementioned and other disadvantages.

SUMMARY OF THE INVENTION

One aspect of the present invention provides a shoulder belt height adjuster assembly. The assembly includes a guide rail, a slide, and a biasing member. The guide rail includes a plurality of fixed rail teeth disposed along at least one longitudinal portion. The slide includes an aperture formed therein for slidably receiving the guide rail along the longitudinal portion. The slide further includes a plurality of fixed slide teeth disposed on an interior slide surface. The biasing member is operably attached to the slide aperture for selectively engaging at least one of the fixed slide teeth into at least one of the fixed rail teeth. The engagement prevents slidable movement of the slide relative to the guide rail in a downward direction.

Another aspect of the invention provides a method of adjusting height of a motor vehicle shoulder belt assembly. The method includes selectively preventing sliding movement of a slide relative to a guide rail, sliding the slide in an upward direction by applying an upward force, and sliding the slide in a downward direction by applying a pressing force and a downward force.

Yet another aspect of the present invention provides a shoulder belt height adjuster assembly. The assembly includes means for selectively preventing sliding movement of a slide relative to a guide rail, means for sliding the slide in an upward direction by applying an upward force, and means for sliding the slide in a downward direction by applying a pressing force and a downward force.

The foregoing and other features and advantages of the invention will become further apparent from the following detailed description of the presently preferred embodiments, read in conjunction with the accompanying drawings. The detailed description and drawings are merely illustrative of the invention, rather than limiting the scope of the invention being defined by the appended claims and equivalents thereof.

BRIEF DESCRIPTION OF THE DRAWINGS

FIG. 1 is an exploded view of a shoulder belt height adjuster assembly in accordance with the present invention for a motor vehicle;

FIG. 2 is a perspective view of a slide and attached biasing member of the assembly shown in **FIG. 1**;

FIG. 3A is a perspective view of an assembled shoulder belt height adjuster assembly of **FIG. 1**;

FIG. 3B is a detailed view of a portion of a guide rail shown in **FIG. 3A**; and

FIGS. 4A and 4B are schematic views of alternative shoulder belt height adjuster assemblies being mounted on vehicle pillars in accordance with the present invention.

DESCRIPTION OF THE PRESENTLY PREFERRED EMBODIMENTS

Referring to the drawings, wherein like reference numerals refer to like elements, **FIG. 1** an exploded view of a shoulder belt height adjuster assembly in accordance with the present invention, shown generally by numeral **10**, for a motor vehicle. Assembly **10** includes a guide rail **20**, a slide **30**, and a biasing member **40**. Guide rail **20** includes a plurality of fixed rail teeth **22** disposed along at least one, in this case two, longitudinal portions **24a**, **24b**. The slide **30** includes an aperture **32** formed therein for slidably receiving the guide rail **20** along the longitudinal portions **24a**, **24b**. Slide **30** further includes a plurality of fixed slide teeth **34** disposed on an interior slide surface **36**. In the present description, the term "fixed" is meant to describe gear-like teeth structures that are not moveable relative to an underlying surface. For example, the fixed slide teeth **34** are not moveable (e.g. rotatable, slidable, etc.) relative to the interior slide surface **36**.

In one embodiment, the guide rail **20** may be formed from a single piece that is substantially U-shaped and may have a cross-sectional shape that is square, rectangular, oval, or circular. Guide rail **20** may be manufactured from a sufficiently rigid material such as steel, metal, metal alloy, composite, and the like. Guide rail **20** may be formed, for example, by bending an elongated bar piece into the U-shape. Fixed rail teeth **22** may be formed on the guide rail **20** by, for example, a broaching process. Those skilled in the art will recognize that the guide rail **20** geometry, material, fixed rail teeth **22**, and method of manufacturing the same may vary without limiting the function of the present invention.

In one embodiment, the biasing member **40** may be shaped to provide a biasing force within the slide aperture **32**. Biasing member **40** may be substantially U-shaped to "fit" around a threaded slide channel **38**. Furthermore, clip ends **42** may be provided to attach (e.g., "clip") the biasing member **40** to the slide **30**. The biasing member **40** may include at least one, and in this case four, bend formations **44**. Biasing member **40** is typically manufactured from a relatively elastic material thus allowing the bend formations **44** to naturally maintain their shape. As such, lateral compression of the bend formations **44** provides the biasing force that selectively engages the fixed slide teeth **34** into the fixed rail teeth **22**. Those skilled in the art will recognize that the biasing member **40** geometry, material, and bend formations **42** may vary while still providing the biasing force.

Assembly **10** may include a D-ring **50** for operably attaching the slide **30** to a shoulder belt (not shown). In one embodiment, the D-ring **50** may be attached to the slide **30** with a threaded D-ring bolt **52** received within the threaded slide channel **38**. A D-ring cover **54** may be provided to cover the D-ring **50** and D-ring bolt **52**. The shoulder belt may be positioned through openings **56, 58** formed in the D-ring **50** and D-ring cover **54**, respectively. D-ring bolt **52** may provide a swivel attachment of the D-ring **50** and D-ring cover **52** thereby allowing a swivel motion of the shoulder belt.

Assembly **10** may further include at least one mount **60** for operable attachment to the motor vehicle. Numerous mount designs may be used to operably attach the assembly **10** to the vehicle and include, but are not limited to, bolt mounts, hook mounts, pocket mounts, and the like. The number, position, and design of the mounts may vary based on the design of the assembly **10** and/or the motor vehicle.

In one embodiment, which is also shown **FIG. 4A**, a bolt mount **60** may be positioned near the guide rail **20** U-bend. Bolt mount **60** may include a bracket **62** and a threaded bolt **64**, which is received in a threaded opening **74** formed in a vehicle pillar **72**. This provides a first point of attachment. A second point of attachment is provided by inserting the guide rail **20** (see arrows **A**) into a pocket mount **76**. Pocket mount **76** is attached to the vehicle pillar **72** and includes opening(s) to receive ends of the guide rail **20**. As such, the bolt mount **60** and pocket mount **76** provide means of attaching the assembly **10** to a vehicle **70**.

In another embodiment, which is shown **FIG. 4B**, a bolt mount **60b** may provide a first point of attachment. A second point of attachment may be provided by inserting one or more guide rail hooks **26** (see arrows **B**) into corresponding openings **78** formed in the vehicle pillar **72b**. As such, the bolt mount **60b** and guide rail hooks **26** provide means of attaching an assembly **10b** to a vehicle **70b**. It should be recognized that numerous strategies exist for attaching the shoulder belt height adjuster assembly to the vehicle and that the present invention is not limited to the aforementioned examples.

Turning now to **FIG. 2**, a perspective view of the slide **30** and attached biasing member **40** is shown. Fixed slide teeth **34** may have a rounded configuration and formed in the interior slide surface **36** by a variety of methods including, but not limited to, stamping, broaching, casting, and forging. Biasing member **40** may be received within the slide aperture **32** and is shown positioned therein with attached clip ends **42**. Slide **30** may include two slide portions **31a**, **31b** slidably received one to another thereby providing a range of motion (as shown by arrows **C**). Specifically, slide portion **31b** flanges **35a**, **35b** may be slidably received within slide portion **31a** flanges **37a**, **37b**.

Furthermore, the threaded slide channel **38**, which may be integral to slide portion **31b**, may be slidably received by an opening **33** formed in slide portion **31a**. The opening **33**, threaded slide channel **38**, and/or flanges **35a, 35b, 37a, 37b** may include means known to one skilled in the art to prevent the two slide portions **31a, 31b** from separating.

Referring now to **FIG. 3A**, the shoulder belt height adjuster assembly **10** is shown assembled. During operation of the assembly **10**, sliding movement of the slide **30** relative to a guide rail **20** is selectively prevented. This may be achieved by selectively engaging the fixed slide teeth into fixed rail teeth **22**. The biasing member **40** provides the biasing force that biases the fixed slide teeth into the fixed rail teeth **22**. In its default position, the assembly **10** fixed slide teeth are engaged into the fixed rail teeth **22** thereby setting the height. This set height typically does not change without further manipulation (e.g., adjustment by a vehicle passenger). The fixed rail teeth **22** provide numerous discrete slide **30** adjustment positions, without the need for numerous openings in the guide rail **20**. Therefore, the assembly **10** may advantageously provide more shoulder belt height adjustment positions over the prior art.

The assembly **10** height may be adjusted by sliding the slide **30** in an upward direction (as indicated by arrow **D**). The upward adjustment is achieved by applying an upward force (e.g., in direction of arrow **D**) to the slide **30**. In one embodiment, as the upward force is applied, the slide **30** may ratchet to the guide rail **20** in the upward direction thereby incrementally setting new height positions. A detailed view of a portion **23** of the guide rail **20** is shown in **FIG. 3B**. Fixed rail teeth **22** may have a saw-tooth configuration **25**. The configuration **25** provides means for ratcheting the slide wherein it is free to move in the upward direction **D**, however, movement in a downward direction (as indicated by arrow **E**) is not permitted. Referring again to **FIG. 3A**, the slide **30** may be adjusted in the upward direction **D** until the upward force is released or until the slide **30** reaches an upper limit in its range of motion.

The assembly **10** height may also be adjusted by sliding the slide **30** in the downward direction **E**. The downward adjustment is achieved by applying to the slide **30** a pressing force (e.g., in direction of arrow **F**) and a downward force (e.g., in direction of arrow **E**). In one embodiment, slidable movement of the slide **30** in the downward direction **E** is prevented by the engagement of the fixed slide teeth into the fixed rail teeth **22**. Application of the pressing force, however, releases the biasing force and thereby disengages the fixed slide teeth from the fixed rail teeth **22**. As such, the slide **30** is free to slide in the downward direction **E** provided that the downward force is simultaneously applied. Given that the slide **30** and attached components have mass, the downward force may be sufficiently provided by gravity alone. Alternatively, the downward force may be provided by a vehicle passenger, electric motor, or other means. Slide **30** may be adjusted in the downward direction **E** until the pressing force and/or the downward force is/are released or until the slide **30** reaches a lower limit in its range of motion.

Assembly **10** may further include features to provide the upper and lower limits of the slide **30** range of motion. For example, the slide **30** motion may be limited by physical contact with the mount(s), reaching a sliding point where the fixed slide teeth can no longer engage the fixed rail teeth **22**, providing flanges (not shown) in the guide rail **20**, or by other means.

It is important to note that the "upward" and "downward" directions presently used are relative and are provided to merely illustrate the operation of the shoulder belt height assembly while mounted in a vehicle. The upward and downward directions discussed herein are meant to describe any two directions that are roughly 180 degrees one to another. Those skilled in the art will recognize that the height adjustment and applied force directions may vary and that the present invention is not limited to the present embodiments.

While the embodiments of the invention disclosed herein are presently considered to be preferred, various changes and modifications can be made without departing from the spirit and scope of the invention. For example, the shoulder belt height assembly, and the method of operation are not limited to any particular design or sequence. For example, the slide, guide rail, and biasing member geometry, size and length, material constitution, relative position, and fixed teeth configuration may vary without limiting the utility of the invention.

Upon reading the specification and reviewing the drawings hereof, it will become immediately obvious to those skilled in the art that myriad other embodiments of the present invention are possible, and that such embodiments are contemplated and fall within the scope of the presently claimed invention. The scope of the invention is indicated in the appended claims, and all changes that come within the meaning and range of equivalents are intended to be embraced therein.